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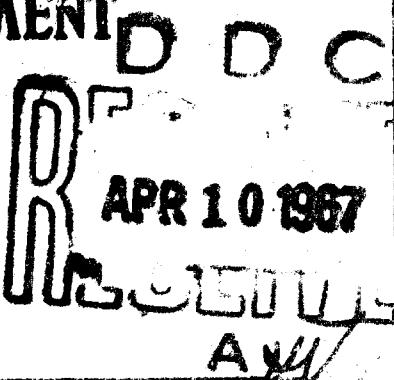
AUTHORITY

USAWC ltr dtd 13 Jul 1972

SPRINGFIELD ARMORY

RESEARCH AND DEVELOPMENT

TECHNICAL REPORT

PROJECT TITLE ___ NONE _____

PROJECT NO. ___ NONE ___ .

REPORT TITLE ___ DEVELOPMENT OF ACCURACY

ACCEPTANCE METHOD FOR CAL..30 M1 RIFLES.

SPRINGFIELD, MASSACHUSETTS

ITEM .30 R M1   DATE 15 June 1948   SA-TR 11-1017
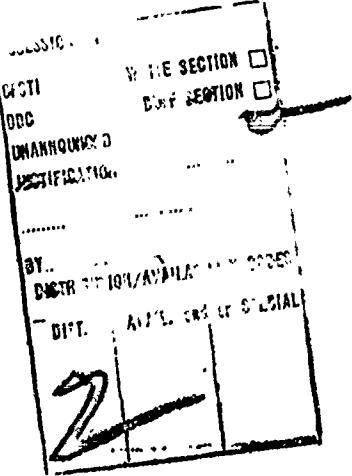
RESEARCH AND DEVELOPMENT DIVISION

SPRINGFIELD ARMORY

TITLE: (6) Development of Accuracy Acceptance Method
for Cal..30 M1 Rifles.

REPORT NO: (14) SA-TR11-1017

AUTHORITY: 00474.2/1902, SA472.2/158
J.O. 6800-6880

(9) Technical rept.,

DATE: (11) 15 June 48

(12) 20p.

(10) H. F. Hawthorne

RESEARCH AND DEVELOPMENT DIVISION
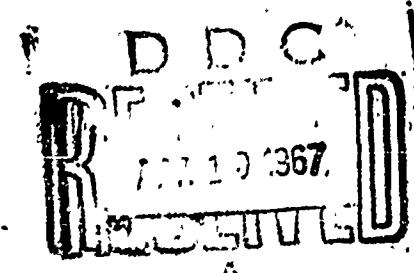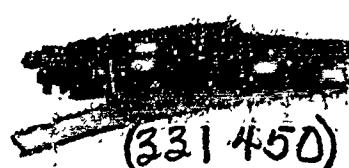
SPRINGFIELD ARMORY

15 June 1948

PROJECT NO: NONE

PROJECT TITLE: NONE

REPORT TITLE: Development of Accuracy Acceptance Method for
                   Cal..30 M1 Rifles.

AUTHORITY: 00474.2/1902, SA472.2/158, J.O. 6800-6880

PRIORITY: 3A

OBJECT: To develop an acceptance plan for accuracy
                   evaluation of the Cal..30 M1 Rifle which
                   would be independent of fluctuations due
                   to variations in ammunition quality.

SUMMARY: An investigation was made of the effect of
                   rifles and of ammunition on dispersion pat-
                   terns used for acceptance for accuracy. A
                   method was developed which permits adjust-
                   ment of the final acceptance value to com-
                   pensate for variations in accuracy of am-
                   munition used.

RECOMMENDATIONS: Recommendation is made that this method be
                   incorporated in U. S. Army Specification
                   52-1-21 to replace the present fixed ac-
                   curacy limit.

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Subject:

Development of Accuracy Acceptance Method for Cal..30
M1 Rifles.

References:

OO474.2/122, SA474.2/2343
OO474.2/1902, SA472.2/158
SA. W.O. 920

Introduction:

The U. S. Army Specification 52-1-21 states that accuracy
requirements of the specification are to be met with standard
service ammunition of known accuracy. This, at the initial
time of writing, was Cal..30 M1 Ball Ammunition which gave ex-
cellent performance. During the war, the standard service am-
munition was changed to M2 Ball and employed two types of bullet,
the M2 Ball which was gilding metal jacketed and the M2 Ball
alternative which was gilding metal clad steel jacketed. With
the increased war time production and the change in type of bul-
let the accuracy of ammunition decreased. Since the specification
does not allow any compensating change in accuracy acceptance
limits, the rifle then had to absorb the increase in group size
due to ammunition. This was manifestly impossible. Accordingly,
a waiver was granted which permitted continued use of M1 Ball
ammunition. This condition continued throughout the production
of new rifles.

In the meantime, eighty-seven Cal..30 M1 Rifles were selected
as being within drawing tolerances on those dimensions believed to
affect accuracy. These were not of exceptional accuracy but merely
representative of what could be expected of rifles manufactured to
existing drawings. These rifles were fired with M1 Ball and with
M2 Ball ammunition to determine the relationship existing between
the two types of ammunition. Report of results is contained in
W.O. 920. In brief, it was shown that due to the increased disper-
sion shown by both rifle and Mann barrel firings of the then avail-
able Cal..30 M2 Ball ammunition, it was impossible to meet the rifle
specification with rifles made to drawing dimensions. Acceptance
plans were submitted for comment.

Shortly after, the production of new rifles stopped and no
action was taken on this report. Cal..30 M1 Ball ammunition con-
tinued to be used for acceptance firing of remanufactured rifles
until such time as existing supplies of M1 Ball ammunition neared
exhaustion. The question of development of a specification which

would provide flexible acceptance limits to allow for variations
in ammunition accuracy was again raised and the project reactivated
to allow for the inclusion of experience accumulated since the
original study was made.

Material & Equipment:

50 Rifles, U. S., Cal..30, M1, selected for conformance
with drawing dimensions and tolerances as listed in Report NO.920.

Cartridges, Cal..30, M2 Ball, Lot DM21046.

Cartridges, Cal..30, M1 Ball, Lot FA2149--2149A.

Cartridges, Cal..30, M2 Ball, Lot LC13305.

Mann Barrel, Cal..30

Machine Rest and Range Facilities.

Procedure:

Because of the variation found to exist between successive
five-shot groups fired with the same M1 Rifle and because of the
greater amount of information obtained relative to basic accuracy
with the larger group, it was decided to establish data on the
basis of eight-shot targets. Accordingly, each of the fifty rifles
was fired five eight-shot targets from a machine rest using the
M1 Ball and the M2 Ball Ammunition, Lot DM21046. Twenty-two of
the rifles were fired similarly with the LC13305 lot of M2 Ball
Ammunition. Each lot of ammunition was fired ten eight-shot groups
from a Mann barrel.

Results & Discussion:

a. The theory was offered that it would be possible to
break down the combined dispersion due to rifle and to ammunition
in such a manner that it would be possible to evaluate each portion
separately. Thus, it would be possible to fire a new lot of am-
munition through a Mann barrel and, with the accuracy factors then
known for the ammunition and for acceptable rifles, to determine
the acceptance limit to be used with that particular lot.

b. It was believed that the combined dispersion would be
represented as the square root of the sum of the squares of the
individual dispersions attributable to rifle and to ammunition in
the same manner that probable errors or standard deviations of a
sum are obtained. This would be expressed as follows:

$$E\,S_{sp.} = \sqrt{E\,S^{2}_{Mann} + E\,S^{2}_{Rifle}}$$

where

    $E\,S_{sp.}$ = Extreme Spread for Specification use and being a combination of rifle and ammunition error.

    $E\,S_{Mann}$ = Extreme Spread of Test Ammunition as determined in Mann barrel.

    $E\,S_{Rifle}$ = Extreme Spread attributable to Rifles alone. (In this test, due to the rifles selected as within drawing tolerances.)

    c. With this as a basis, the 250 targets obtained with the selected rifles and M1 Ball Ammunition were measured and the values of extreme spread taken as $E\,S_{sp.}$ see Table I. The firings with the Mann barrel were taken as $E\,S^{2}_{Mann}$ (Table II) and by substitution, the value of $E\,S_{Rifle}$ was obtained. Then as a check on the validity of this theory, the specification values for use with the lots of M2 Ball Ammunition were derived using the rifle factor $E\,S_{Rifle}$ and the ammunition factor $E\,S_{Mann}$ obtained by Mann barrel firing with M2 Ball. The specification values were compared with actual values obtained from targets fired with the selected rifles and M2 Ball Ammunition (Tables III & IV) with percentage limits for distribution determined by the standard deviation of the Mann barrel firings.

Results are as follows:

(a) M1 Ball

	Rifles	Mann Barrel
Ave. Extreme Spread	3.88	1.49
Ave. E. S. + 1 Std. Deviation	4.978	1.538
Ave. E. S. + 2 Std. Deviation	6.076	1.586
Ave. E. S. + 3 Std. Deviation	7.174	1.634

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Then, substituting in $ES_{sp.} = \sqrt{ES_{Mann}^2 + ES_{Rifle}^2}$

and assuming the value noted under "Rifle" above as $ES_{sp.}$ and solving for ES_{Rifle}, these values are obtained:

at Average	3.58
at + 1 Standard Deviation	4.739
at + 2 Standard Deviations	5.870
at + 3 Standard Deviations	6.989

If these latter values then are considered constant and accepted as representing the dispersion due to rifles alone and combined with the dispersions obtained in Mann barrel firings of the M2 Ball ammunition noted below, the specification value $ES_{sp.}$ for use with M2 Ball ammunition is derived.

(b) M2 Ball Lot DM 21046

Mann Barrel

Ave. Extreme Spread	2.53
Ave. E. S. + 1 σ	2.59
Ave. E. S. + 2 σ	2.65
Ave. E. S. + 3 σ	2.71

$ES_{sp.}$

Ave. Extreme Spread	4.39
Ave. E. S. + 1 σ	5.40
Ave. E. S. + 2 σ	6.44
Ave. E. S. + 3 σ	7.50

(c) M2 Ball Lot LC 13305

Mann Barrel

Ave. Extreme Spread	2.54
Ave. E. S. + 1 σ	2.61
Ave. E. S. + 2 σ	2.68
Ave. E. S. + 3 σ	2.76

$ES_{sp.}$

Ave. Extreme Spread	4.40
Ave. E. S. + 1 σ	5.41
Ave. E. S. + 2 σ	6.45
Ave. E. S. + 3 σ	7.51

(d) For check, actual targets fired with the selected rifles were measured and the distribution of targets compared to the conventional normal curve limits:

1 σ Limit - 68.27%
2 σ Limit - 95.45%
3 σ Limit - 99.73%

with results as shown:

M2 Ball - DM 21046

	No. targets	%	Predicted %
Within 1 σ limit	207	82.8	68.3
Within 2 σ limit	236	94.4	95.4
Within 3 σ limit	243	97.2	99.7
Over 3 σ limit	7		
Total	250		

M2 Ball - LC 13305

	No. targets	%	Predicted %
Within 1 σ limit	87	79.8	68.3
Within 2 σ limit	105	96.3	95.4
Within 3 σ limit	109	100.0	99.7

(e) It is believed that while the accuracy of prediction is not good for the 1 σ limits, it is sufficiently valid for the higher limits to warrant adoption and is an improvement over the present method setting an arbitrary limit which does not permit of adjustment for ammunition quality.

Inasmuch as the rifles used represent the variations to be expected within drawing limits, the accuracies obtained may be considered as representative of the current design and the limits used should be such as to permit acceptance of the major portion of these rifles. It is believed that use of this method of acceptance with limits set at the 2 σ point would provide a satisfactory method of inspection.

Conclusions:

1. It is concluded that the dispersion pattern of shots obtained in targeting of rifles can be broken into two factors, one attributable to the rifles and the other to the ammunition. Further, the factor due to rifles has been evaluated with rifles selected for being within tolerances with sufficient accuracy that a method can be presented which will allow prediction of targeting results with any

lot of ammunition if Mann barrel firing results with this ammunition are obtained.

2. It is also concluded that this method will provide acceptance limits which are more nearly true than those in the present specification and which can be met with rifles manufactured to drawing tolerances.

Recommendations:

It is recommended that U. S. Army Specification 52-1-21 be changed to permit use of a method of determining acceptance limits for accuracy as outlined in this report and that the limits be set at the 2 c point.

Submitted: _H. F. HAWTHORNE_
Ord. Engineer
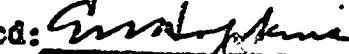
Reviewed: _E. W. HODGES_
Head Ord. Engineer

Approved: _F. J. McMORROW_
Lt. Col., Ord. Dept.

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TABLE I (1st Set)

TARGETING RESULTS – M1 RIFLES WITH M1 BALL AMMUNITION

LOT FA 2149A

SERIAL NO.	EV.	EH.	ES.		SERIAL NO.	EV.	EH.	ES.
3826637	3.1"	1.6"	3.1"		3826637	2.1"	2.6"	3.0"
3825201	3.8	0.9	3.8-		3825201	1.4	3.3	3.3-
3825870	5.1	2.8	5.1-		3825870	5.0	3.3	5.3-
3826834	2.9	1.9	2.9-		3826834	2.4	1.6	2.5-
3826236	4.1	2.1	4.5		3826236	4.4	2.3	4.4-
3826600	5.0	3.2	5.0-		3826600	4.0	3.0	4.3-
3826613	2.1	1.7	2.3-		3826613	3.5	3.0	3.5-
3814093	5.4	4.0	6.1 —xx		3814093	2.5	1.4	2.5-
3826479	2.1	2.0	2.2-		3826479	4.7	1.6	4.7-
3826050	6.1	5.2	6.9-		3826050	3.1	4.2	5.0
3826637	2.9	2.8	3.6		3826637	1.4	2.7	2.7
3825201	1.9	2.9	3.2-		3825201	2.4	1.5	2.8-
3825870	3.0	3.0	3.8-		3825870	2.4	4.3	4.3-
3826834	3.4	3.0	3.4-		3826834	3.2	2.9	3.3-
3826236	2.9	3.0	3.3-		3826236	5.4	2.8	5.6 —x
3826600	3.8	4.5	4.6-		3826600	6.0	1.3	6.0-
3826613	1.9	1.8	2.4-		3826613	6.0	1.8	6.1-
3814093	3.6	4.6	5.6-		3814093	2.9	4.1	4.8-
3826479	3.0	2.1	3.3-		3826479	4.3	1.9	4.6
3826050	3.5	3.0	4.1		3826050	3.9	2.8	5.2-
3826637	3.5	3.7	3.8					
3825201	1.1	2.2	2.3-					
3825870	2.6	3.4	4.2-					
3826834	2.3	3.0	3.0-					
3826236	5.2	2.1	5.3 —y					
3826600	4.1	2.8	5.0-					
3826613	5.0	2.0	5.1-					
3814093	6.3	2.2	6.5 —xx					
3826479	5.3	2.5	5.4-					
3826050	4.0	3.6	4.8-					

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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TABLE I (2nd Set)

TARGETING RESULTS - M1 RIFLES WITH M1 BALL AMMUNITION

LOT FA 2149A

SERIAL NO.	EV.	EH.	ES.		SERIAL NO.	EV.	EH.	ES.
3826061	2.6"	3.5"	4.1"		3826061	3.5"	4.2"	4.5"
3825688	7.4	2.8	7.7		3825688	2.8	2.1	3.2
3826303	3.4	4.2	3.5		3826303	4.4	3.3	5.5
3825315	6.2	2.2	6.2		3825315	3.3	3.0	3.6
3825084	1.9	3.2	3.7		3825084	3.9	3.5	4.7
3825536	1.6	4.2	4.3		3825536	2.3	2.6	3.2
3826318	1.9	3.0	3.6		3826318	1.9	3.1	3.3
3826663	2.5	1.3	2.8		3826663	2.7	3.7	3.2
3826571	3.3	3.2	4.0		3826571	4.3	3.4	4.3
3812640	3.4	2.8	3.9		3812640	3.6	4.3	5.6
3826061	1.9	1.7	3.1		3826061	3.4	4.1	4.5
3825688	6.5	2.2	6.6		3825688	4.6	2.7	5.3
3826303	2.7	2.8	3.9		3826303	4.1	5.5	6.3
3825315	2.5	3.8	4.0		3825315	4.8	3.0	5.1
3825084	3.0	2.1	3.3		3825084	3.7	2.4	4.1
3825536	3.1	1.6	3.1		3825536	3.4	2.9	3.9
3826318	2.3	3.8	4.2		3826318	3.7	4.9	5.8
3826663	5.0	2.0	5.0		3826663	3.5	3.2	4.0
3826571	3.3	3.3	3.5		3826571	2.2	1.9	2.5
3812640	1.8	2.6	2.9		3812640	3.7	3.8	4.6
3826061	3.0	4.0	5.1					
3825688	4.6	2.3	4.7					
3826303	2.0	2.3	2.5					
3825315	3.7	4.7	4.8					
3825084	3.5	4.5	5.1					
3825536	2.4	1.8	2.8					
3826318	1.4	4.7	4.8					
3826663	4.5	2.4	4.6					
3826571	4.3	3.2	4.6					
3812640	3.1	4.5	4.5					

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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TABLE I (3rd Lot)

TARGETING RESULTS - M1 RIFLES WITH M1 BALL AMMUNITION

LOT FA 2149A

SERIAL NO.	EV.	EH.	ES.	SERIAL NO.	EV.	EH.	ES.
3824505	2.7"	2.5"	3.7"	3824505	5.0"	2.2"	5.1"
3826669	2.0	1.3	2.3	3826669	4.2	3.1	5.2
3826703	2.8	3.3	2.3	3826703	5.2	3.4	5.5
3825657	2.3	1.8	2.9	3825657	3.1	1.4	3.3
3825957	1.7	2.2	2.4	3825957	1.7	4.0	4.0
3812297	2.9	1.6	3.2	3812297	3.5	2.5	3.6
3826276	3.1	2.8	3.4	3826276	3.3	2.9	3.5
3826674	2.3	3.3	3.4	3826674	2.2	3.2	3.0
3825689	4.9	2.7	4.9	3825689	3.9	2.1	3.9
3826728	2.5	5.0	5.0	3826728	1.4	3.8	4.0
3824505	3.9	2.7	3.9	3824505	4.7	2.7	4.7
3826669	2.4	3.0	3.7	3826669	4.4	2.5	4.6
3826703	2.8	1.6	2.8	3826703	2.8	2.1	2.9
3825657	1.4	1.7	1.8	3825657	2.0	1.7	2.4
3825957	2.7	2.2	2.8	3825957	1.8	2.6	2.9
3812297	2.5	3.1	3.1	3812297	3.1	2.6	3.1
3826276	4.6	2.6	4.6	3826276	2.9	1.6	3.0
3826674	2.3	2.4	3.1	3826674	3.0	2.7	3.2
3825689	4.7	2.7	5.0	3825689	2.7	3.2	3.4
3826728	2.8	4.0	5.0	3826728	4.3	2.3	4.4
3824505	2.5	3.1	3.4				
3826669	2.6	1.9	2.6				
3826703	0.9	4.4	4.5				
3825657	2.0	2.6	2.8				
3825957	2.0	1.6	2.0				
3812297	3.4	3.6	4.8				
3826276	1.8	1.2	2.0				
3826674	3.4	2.7	4.0				
3825689	2.7	2.0	2.9				
3826728	3.0	3.1	4.2				

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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TABLE I (4th Set)

TARGETING RESULTS - M1 RIFLES WITH M1 BALL AMMUNITION

LOT FA 2149A

SERIAL NO.	EV.	EH.	ES.		SERIAL NO.	EV.	EH.	ES.
3825975	2.7"	1.6"	2.8"		3825975	2.4"	2.1"	2.6"
3825326	3.2	2.5	3.2		3825326	3.0	3.4	4.2
3825248	3.2	2.5	3.6		3825248	2.5	3.7	3.9
3825480	2.2	3.9	4.0		3825480	3.5	1.6	3.6
3825324	2.0	1.7	2.3		3825324	4.6	2.6	5.0
3826506	2.5	1.6	2.7		3826506	2.0	1.6	2.2
3821532	2.4	1.6	3.4		3821532	1.7	3.5	3.5
3826302	3.0	2.0	3.0		3826302	1.6	1.9	2.3
3826710	4.9	3.6	4.9		3826710	3.4	2.5	3.4
3825655	1.8	3.0	3.0		3825655	3.7	2.0	3.7
3825975	4.8	1.8	4.8		3825975	2.0	3.3	3.3
3825326	5.7	4.1	6.1		3825326	2.3	2.6	2.7
3825248	1.4	2.9	3.0		3825248	3.6	1.7	3.7
3825480	3.3	2.8	3.3		3825480	1.9	2.6	3.2
3825324	4.2	1.6	4.4		3825324	3.4	2.6	3.7
3826506	2.2	2.8	2.2		3826506	2.7	2.5	3.1
3821532	2.4	3.0	3.8		3821532	2.3	1.6	2.3
3826302	2.8	1.5	3.0		3826302	2.0	2.2	2.4
3826710	2.3	2.7	2.7		3826710	4.9	1.3	5.1
3825655	2.9	4.4	4.4		3825655	5.3	4.2	6.6
3825975	3.4	3.1	4.1					
3825326	2.1	3.7	3.7					
3825248	4.8	3.9	5.7					
3825480	3.4	3.4	4.2					
3825324	3.9	2.7	4.5					
3826506	2.8	1.7	2.8					
3821532	3.6	3.4	3.7					
3826302	3.6	1.2	3.6					
3826710	2.2	1.3	2.3					
3825655	3.9	3.7	4.4					

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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TABLE I (5th Set)

TARGETING RESULTS - M1 RIFLES WITH M1 BALL AMMUNITION

LOT FA 2149A

SERIAL NO.	EV.	EH.	ES.		SERIAL NO.	EV.	EH.	ES.
3825613	3.0"	2.6"	4.0"		3825613	2.8"	2.5"	3.4"
3826581	2.5	2.7	2.8		3826581	2.0	1.9	2.0
3825698	6.0	2.5	6.0		3825698	4.0	2.2	4.2
3825730	4.5	3.3	4.9		3825730	4.6	2.4	4.9
3822080	2.0	4.1	4.2		3822080	3.2	3.1	3.7
3826846	4.8	3.3	5.4		3826846	4.5	1.6	4.7
3825685	3.5	3.4	4.6		3825685	4.0	2.0	4.0
3826323	1.2	3.4	3.5		3826323	2.4	1.9	2.4
3824980	2.0	1.8	2.0		3824980	2.2	2.8	3.0
3826470	2.5	2.8	3.3		3826470	5.2	1.5	5.2
3825613	3.4	3.9	4.2		3825613	4.7	2.4	5.3
3826581	2.6	2.3	3.3		3826581	3.6	3.0	3.8
3825698	2.4	1.7	2.6		3825698	1.9	2.9	2.9
3825730	5.4	3.1	5.4		3825730	4.2	4.1	4.5
3822080	2.7	5.8	6.0		3822080	1.6	3.8	4.0
3826846	3.5	3.0	3.6		3826846	4.7	1.8	4.7
3825685	2.2	2.6	3.2		3825685	3.5	2.5	3.5
3826323	2.8	2.6	3.1		3826323	4.0	1.2	4.0
3824980	2.5	2.1	2.6		3824980	2.0	0.8	2.1
3826470	2.4	2.0	2.5		3826470	2.1	2.8	3.4
3825613	2.4	3.0	3.8					
3826581	2.8	2.5	3.2					
3825698	3.7	2.5	4.4					
3825730	2.2	2.6	3.2					
3822080	3.2	3.4	3.8					
3826846	3.7	4.0	5.4					
3825685	4.1	2.5	4.1					
3826323	1.5	1.4	2.0					
3824980	3.2	2.7	3.3					
3826470	4.4	2.3	4.4					

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

TABLE II

TARGETING RESULTS - MAIN BARREL FIRINGS

Ammunition Type and Lot	Extreme Vertical	Extreme Horizontal	Extreme Spread
M1 Ball FA 2149	0.9"	1.6"	1.7"
	0.8	1.2	1.3
	1.2	1.4	1.5
	0.6	0.4	0.6
	0.9	1.8	1.8
	1.2	2.3	2.4
	1.2	0.6	1.3
	1.2	0.9	1.2
	1.3	1.7	2.0
	0.7	1.1	1.1
M2 Ball Alt. DM 21046	1.8	1.0	1.9
	1.4	1.1	1.4
	1.6	3.5	3.5
	2.2	2.6	3.1
	2.5	0.6	2.5
	2.3	2.3	2.6
	2.5	1.4	2.5
	1.7	1.8	2.1
	2.9	2.7	3.2
	2.1	2.4	2.5
M2 Ball Alt. LC 13305	2.1	2.7	2.7
	1.0	1.7	1.7
	1.8	2.5	2.5
	2.2	2.3	2.3
	1.2	1.8	1.8
	2.0	2.0	2.0
	2.6	3.1	3.8
	1.7	3.6	3.9
	2.1	2.1	2.5
	2.2	1.0	2.2

All targets obtained were eight-shot groups.

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RESTRICTED

TABLE III (6th Set)

TARGETING RESULTS - M1 RIFLES - M2 BALL ALT. AMMUNITION

LOT DM 21046

SERIAL NO.	EV.	EH.	ES.	SERIAL NO.	EV.	EH.	ES.
3825613	3.2"	1.9"	3.5"	3825613	2.7"	2.6"	3.3"
3826581	4.9	2.6	4.8	3826581	2.5	3.8	4.6
3825698	5.5	2.9	5.5	3825698	3.4	2.0	3.7
3825730	5.1	4.0	5.3	3825730	3.1	3.7	4.3
3822080	3.4	3.8	3.8	3822080	3.0	3.8	4.1
3826846	2.8	4.8	5.5	3826846	4.1	2.7	4.5
3825685	4.7	2.0	5.0	3825685	2.5	2.1	3.0
3826323	2.9	1.7	3.0	3826323	3.9	2.7	4.1
3824980	3.7	4.1	3.8	3824980	4.6	2.9	4.9
3826470	2.6	2.9	3.1	3826470	3.1	3.0	3.7
3825613	3.8	2.8	3.9	3825613	6.3	6.1	6.4
3826581	1.7	2.8	2.9	3826581	3.0	4.5	4.6
3825698	4.0	3.8	4.7	3825698	4.2	3.1	5.1
3825730	4.9	2.5	5.0	3825730	5.4	3.0	5.4
3822080	3.8	2.3	4.0	3822080	1.5	4.7	4.8
3826846	2.3	2.2	2.7	3826846	3.6	3.0	3.8
3825685	6.6	2.7	6.6	3825685	4.8	1.8	4.8
3826323	4.4	3.6	4.7	3826323	3.4	5.0	5.2
3824980	4.3	1.6	4.4	3824980	4.9	2.3	5.1
3826470	4.7	1.7	4.8	3826470	3.1	4.6	4.8
3825613	7.3	3.9	7.9				
3826581	2.8	2.7	3.8				
3825698	3.5	3.2	3.5				
3825730	4.0	1.2	4.0				
3822080	3.6	3.8	4.5				
3826846	4.9	3.1	5.0				
3825685	4.7	3.4	5.3				
3826323	2.9	3.0	3.1				
3824980	4.6	3.1	4.7				
3826470	4.1	3.2	4.4				

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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RESTRICTED

TABLE XII (7th Set)

TARGETING RESULTS - M1 RIFLES - M2 BALL AMT. AMMUNITION

LOT N1 21046

SERIAL NO.	EV.	EH.	ES.		SERIAL NO.	EV.	EH.	ES.
3825665	5.0"	3.6"	5.0"		3825665	3.2"	4.3"	4.3"
3826710	4.0	2.2	4.0		3826710	3.4	2.0	3.7
3826302	2.0	2.9	2.9		3826302	5.3	2.4	5.4
3821532	4.7	2.8	4.7		3821532	3.0	1.8	3.1
3826506	2.5	2.5	2.8		3826506	4.3	2.0	4.8
3825975	4.7	2.9	4.8		3825975	6.4	3.8	6.6
3825326	6.5	3.6	6.9		3825326	4.4	2.0	4.4
3825248	4.6	2.4	4.6		3825248	4.5	3.7	4.8
3825480	2.6	3.6	3.7		3825480	2.5	1.8	2.5
3825324	3.3	2.7	4.1		3825324	4.3	2.6	4.5
3825665	5.2	2.0	5.3		3825665	4.7	2.6	5.1
3826710	5.9	3.9	6.2		3826710	5.2	2.7	5.4
3826302	2.4	4.1	4.2		3826302	2.2	3.7	3.7
3821532	3.8	3.0	4.0		3821532	2.9	1.9	3.0
3826506	3.7	2.7	3.8		3826506	2.0	3.0	3.1
3825975	3.5	2.4	3.8		3825975	5.0	3.8	5.6
3825326	4.5	2.5	4.5		3825326	3.0	5.0	5.0
3825248	6.6	2.7	6.9		3825248	2.6	4.4	5.0
3825480	4.4	3.3	4.6		3825480	3.0	3.4	3.7
3825324	1.9	3.1	3.1		3825324	2.5	3.0	3.4
3825665	2.7	3.5	3.7					
3826710	3.6	1.5	3.8					
3826302	2.0	2.6	2.8					
3821532	3.5	3.3	3.8					
3826506	2.6	5.2	5.4					
3825975	3.2	2.3	3.3					
3825326	4.9	3.4	5.5					
3825248	3.7	4.6	6.0					
3825480	1.5	4.3	4.5					
3825324	2.2	1.4	2.3					

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

TABLE III (7th Set)

TARGETING RESULTS - M1 RIFLES - M2 BALL ALT. AMMUNITION

LOT DM 21046

SERIAL NO.	EV.	EH.	ES.		SERIAL NO.	EV.	EH.	ES.
3825665	5.0"	3.6"	5.0"		3825665	3.2"	4.3"	4.3"
3826710	4.0	2.2	4.0		3826710	3.4	2.0	3.7
3826302	2.0	2.9	2.9		3826302	5.3	2.4	5.4
3821532	4.7	2.8	4.7		3821532	3.0	1.8	3.1
3826506	2.5	2.5	2.8		3826506	4.3	2.0	4.8
3825975	4.7	2.9	4.8		3825975	6.4	3.8	6.6
3825326	6.5	3.6	6.9		3825326	4.4	2.0	4.4
3825248	4.6	2.4	4.6		3825248	4.5	3.7	4.8
3825480	2.6	3.6	3.7		3825480	2.5	1.8	2.5
3825324	3.3	2.7	4.1		3825324	4.3	2.6	4.5
3825665	5.2	2.0	5.3		3825665	4.7	2.6	5.1
3826710	5.9	3.9	6.2		3826710	5.2	2.7	5.4
3826302	2.4	4.1	4.2		3826302	2.2	3.7	3.7
3821532	3.8	3.0	4.0		3821532	2.9	1.9	3.0
3826506	3.7	2.7	3.8		3826506	2.0	3.0	3.1
3825975	3.5	2.4	3.8		3825975	5.0	3.8	5.6
3825326	4.5	2.5	4.5		3825326	3.0	5.0	5.0
3825248	6.6	2.7	6.9		3825248	2.6	4.4	5.0
3825480	4.4	3.3	4.6		3825480	3.0	3.4	3.7
3825324	1.9	3.1	3.1		3825324	2.5	3.0	3.4
3825665	2.7	3.5	3.7					
3826710	3.6	1.5	3.8					
3826302	2.0	2.6	2.8					
3821532	3.5	3.3	3.8					
3826506	2.6	5.2	5.4					
3825975	3.2	2.3	3.3					
3825326	4.9	3.4	5.5					
3825248	3.7	4.6	6.0					
3825480	1.5	4.3	4.5					
3825324	2.2	1.4	2.3					

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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RESTRICTED

TABLE III (8th Set)

TARGETING RESULTS - M1 RIFLES - M2 BALL ALT. AMMUNITION

LOT DM 21046

SERIAL NO.	EV.	EH.	ES.	SERIAL NO.	EV.	EH.	ES.
3824505	5.3"	4.6"	6.3"	3824505	4.6"	2.5"	5.2"
3825657	4.7	3.3	4.8	3825657	3.6	3.2	4.0
3825957	3.5	2.6	3.7	3825957	2.8	2.9	3.4
3826708	5.3	2.6	6.0	3826708	2.3	4.5	4.5
3826669	3.0	3.6	4.1	3826669	1.4	3.2	3.2
3826674	5.2	1.5	5.2	3826674	1.6	4.9	5.0
3826728	5.5	3.2	5.5	3826728	6.6	3.6	6.9
3812297	4.8	4.2	4.8	3812297	3.7	2.6	3.7
3825689	3.7	3.9	4.8	3825689	3.2	4.8	5.3
3826276	3.2	2.6	3.5	3826276	3.9	1.8	4.0
3824505	8.1	2.8	7.7	3824505	4.6	2.3	4.6
3825657	2.6	3.1	3.8	3825657	2.2	3.3	3.3
3825957	3.2	3.0	3.9	3825957	1.5	0.9	1.5
3826708	2.4	3.0	3.1	3826708	1.9	2.4	3.0
3826669	3.9	2.9	4.1	3826669	4.2	5.6	5.7
3826674	2.6	4.1	4.9	3826674	2.5	5.1	5.2
3826728	5.1	3.8	5.5	3826728	4.6	2.0	6.0
3812297	4.4	3.9	4.4	3812297	4.8	4.3	4.9
3825689	2.3	5.5	5.7	3825689	7.8	3.4	7.8
3826276	3.1	2.5	3.2	3826276	4.4	3.1	5.4
3824505	3.2	4.1	4.4				
3825657	4.3	4.0	4.3				
3825957	3.3	2.3	3.8				
3826708	7.0	2.1	7.2				
3826669	1.8	5.9	6.0				
3826674	2.3	3.6	4.0				
3826728	4.1	6.0	6.4				
3812297	3.2	4.0	4.3				
3825689	3.0	1.7	3.0				
3826276	3.6	4.11	5.0				

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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RESTRICTED

TABLE III (9th Set)

TARGETING RESULTS - M1 RIFLES - M2 BALL ALT. AMMUNITION

LOT DM 21046

SERIAL NO.	EV.	EH.	ES.	SERIAL NO.	EV.	EH.	ES.
3812640	2.6"	2.2"	2.8"	3812640	2.9"	2.5"	3.1"
3826318	6.9	6.5	8.8	3826318	4.5	3.8	5.5
3826571	3.0	2.6	3.4	3826571	3.5	1.5	3.8
3826663	2.0	3.0	3.0	3826663	3.1	4.3	4.3
3825536	3.4	4.2	4.8	3825536	2.3	2.4	2.5
3826303	3.5	1.6	3.9	3826303	4.0	4.1	4.2
3825689	1.8	2.1	2.5	3825689	4.8	3.1	5.2
3825315	2.0	3.8	4.1	3825315	4.3	4.0	5.8
3826061	2.8	2.4	3.1	3826061	4.0	2.8	4.6
3825084	3.8	2.4	4.2	3825084	5.1	4.3	5.1
3812640	4.4	4.0	5.2	3812640	5.4	3.3	5.4
3826318	3.7	4.3	5.3	3826318	4.3	3.8	4.5
3826571	3.7	1.8	3.7	3826571	6.4	2.9	6.6
3826663	3.8	3.1	3.8	3826663	4.1	3.0	4.3
3825536	1.4	2.0	2.0	3825536	5.3	4.0	6.0
3826303	2.1	2.4	3.1	3826303	5.1	3.2	5.1
3825689	5.5	1.7	5.5	3825689	6.4	4.5	7.0
3825315	1.8	4.4	4.5	3825315	4.6	5.2	6.2
3826061	2.6	1.8	2.9	3826061	2.4	3.9	4.1
3825084	3.4	3.0	3.9	3825084	5.3	4.2	5.3
3812640	2.2	2.3	2.5				
3826318	4.6	3.6	4.7				
3826571	3.4	3.9	4.1				
3826663	5.0	1.0	5.0				
3825536	1.6	4.9	4.9				
3826303	4.7	3.0	5.1				
3825689	3.2	4.1	4.1				
3825315	5.2	3.3	6.9				
3826061	3.6	3.1	3.8				
3825084	3.5	2.9	4.2				

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

TABLE III (10th Set)

TARGETING RESULTS - M1 RIFLES - M2 BALL ALT. AMMUNITION

LOT EM 21046

SERIAL NO.	EV.	EH.	ES.	SERIAL NO.	EV.	EH.	ES.
3825201	3.7"	2.8"	3.7"	3825201	3.7"	2.7"	4.3"
3826834	2.1	4.1	4.1	3826834	4.6	3.4	4.9
3826236	5.2	2.2	5.3	3826236	3.0	4.3	4.6
3825870	5.3	2.3	5.3	3825870	3.4	3.0	4.5
3826637	4.8	3.2	5.0	3826637	1.7	3.2	3.2
3826600	2.7	2.1	2.8	3826600	3.8	2.6	3.9
3826613	4.0	4.3	4.3	3826613	3.3	3.1	3.5
3826050	2.1	4.4	4.5	3826050	3.7	3.4	5.0
3814093	4.3	1.9	4.4	3814093	3.3	2.7	4.1
3826479	7.7	1.7	7.7	3826479	5.8	3.8	5.9
3825201	2.1	2.6	2.8	3825201	4.1	3.1	4.5
3826834	4.1	2.4	4.2	3826834	2.7	3.0	3.6
3826236	5.0	4.2	5.0	3826236	4.4	4.2	4.7
3825870	5.0	2.8	5.4	3825870	4.1	3.0	4.3
3826637	3.0	3.3	3.8	3826637	3.9	3.8	4.1
3826600	4.7	3.0	4.7	3826600	3.8	3.9	4.1
3826613	5.4	3.8	5.5	3826613	6.4	3.5	6.4
3826050	4.7	3.0	5.2	3826050	1.3	3.4	3.8
3814093	6.0	5.9	6.4	3814093	3.8	5.1	5.1
3826479	5.0	2.4	5.1	3826479	5.3	2.0	5.3
3825201	2.0	1.5	2.3				
3826834	2.0	3.0	3.1				
3826236	4.3	2.1	4.6				
3825870	4.8	3.3	5.7				
3826637	4.6	1.2	4.7				
3826600	5.9	1.8	6.1				
3826613	7.7	3.5	7.7				
3826050	2.3	6.1	6.4				
3814093	3.6	1.4	3.6				
3826479	4.8	3.7	4.8				

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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TABLE IV

TARGETING RESULTS - M1 RIFLES - M2 BALL ALT. AMMUNITION

LC 13305

SERIAL NO.	EV.	EH.	ES.	SERIAL NO.	EV.	EH.	ES.
3826276	1.46"	3.04"	3.10"	3825689	5.10"	2.70"	5.70"
"	3.70	2.40	3.70	"	5.90	2.50	6.30
"	3.80	2.80	4.20	"	6.30	2.40	6.30
"	4.20	3.16	4.40	"	6.80	1.90	6.80
3826728	2.16	1.90	2.24	"	5.20	3.60	5.50
"	2.20	3.50	3.60	3824505	5.40	2.90	5.40
"	3.66	1.70	3.66	"	1.90	2.20	2.70
"	3.40	2.30	3.50	"	5.70	1.50	5.80
"	1.54	3.80	3.84	"	3.80	3.60	3.80
3826276	4.80	4.20	5.30	"	3.00	4.00	4.20
"	6.60	4.00	6.70	3826703	2.30	3.60	4.10
"	2.00	2.90	3.20	"	2.20	1.90	2.80
"	3.50	2.60	3.50	"	3.50	3.60	4.40
"	4.60	3.50	5.20	"	2.40	2.20	3.00
3826674	3.90	1.70	4.00	"	5.32	2.36	5.34
"	2.60	2.10	2.60	3826669	3.20	3.40	4.60
"	2.80	2.90	3.50	"	4.60	2.00	4.60
"	3.30	1.60	3.50	"	4.40	3.40	5.60
"	1.80	.90	1.90	"	3.60	2.70	4.70
3812297	3.20	2.40	3.20	"	1.40	5.00	5.00
"	2.90	2.40	3.10	3825957	5.10	3.80	6.00
"	5.10	3.40	5.80	"	3.90	2.60	4.40
"	3.70	2.90	3.70	"	2.70	2.40	4.30
"	4.70	4.20	5.20	"	3.10	1.70	3.20
3826728	3.00	2.60	3.70	"	4.50	3.20	4.60
"	3.30	2.00	3.60	3825657	4.30	3.70	5.00
"	4.50	4.10	6.20	"	2.20	3.60	3.60
"	2.20	3.70	3.70	"	2.80	3.00	3.90
"	2.90	4.10	4.70	"	3.10	2.80	4.20
				"	4.30	3.60	4.50

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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TABLE IV (Cont.)

TARGETING RESULTS - M1 RIFLES - M2 BALL AIG. AMMUNITION

LC 13305

SERIAL NO.	EV.	EH.	ES.	SERIAL NO.	EV.	EH.	ES.
3826050	6.50"	2.40"	6.50"	3826537	1.80"	4.40"	4.60"
"	6.10	3.00	6.20	"	2.40	3.70	3.80
"	6.00	4.50	7.40	"	3.50	3.00	3.70
"	5.50	2.60	5.80	"	2.90	2.60	3.30
"	5.20	4.30	5.80	"	2.20	3.80	4.10
3826600	3.80	1.30	3.80	3826834	2.60	3.60	4.00
"	1.80	4.10	4.20	"	3.30	3.10	3.90
"	3.80	3.30	3.90	"	2.40	2.90	3.40
"	3.70	1.90	3.70	"	2.50	4.50	4.60
"	6.40	2.00	6.40	"	3.60	3.00	4.20
3826479	3.50	2.10	3.50	3825870	6.00	2.40	6.00
"	5.80	2.70	6.00	"	3.50	3.70	4.00
"	4.40	3.50	5.60	"	5.00	3.00	5.00
"	4.10	2.70	4.10	"	3.80	1.80	3.80
"	4.80	2.10	4.90	"	2.30	2.70	3.50
3814093	5.40	2.00	5.40	3826236	4.20	3.40	4.90
"	3.80	1.60	3.80	"	4.10	1.90	4.20
"	3.40	2.10	3.50	"	5.50	3.20	6.00
"	3.40	2.80	4.30	"	4.00	2.10	4.00
"	1.70	2.20	2.40	"	1.30	2.90	3.00
3826613	5.10	3.30	5.90				
"	1.80	2.50	2.50				
"	1.20	2.70	2.70				
"	2.60	2.90	3.30				
"	1.50	3.10	3.30				
3825201	3.40	4.50	5.50				
"	2.00	3.80	4.30				
"	4.70	1.90	4.70				
"	5.20	3.20	5.20				
"	4.40	4.60	5.00				

EV. = Extreme Vertical
EH. = Extreme Horizontal
ES. = Extreme Spread

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